CBC Grade 10 Mathematics Lesson Plan

Surface Area in Real-Life

Strand	**Measurement and Geometry**
Sub-Strand	Surface Area
Specific Learning Outcome	Explore the use of surface area in real-life situations involving coverage, cost, and material estimates
Key Inquiry Questions	How do we use surface area calculations in everyday life?
Learning Resources	CBC Grade 10 textbooks, measuring tape, calculator, sample objects (boxes, cylinders)
Lesson Duration	40 minutes

Lesson Structure Overview

Phase	**Activity**	**Duration**
Phase 1	Problem-Solving and Discovery (Anchor Activity)	15 minutes
Phase 2	Structured Instruction (Key Takeaways)	10 minutes
Phase 3	Practice and Application (Worked Examples)	15 minutes
Phase 4	Assessment (Exit Ticket)	5 minutes

Phase 1: Problem-Solving and Discovery (15 minutes)

Anchor Activity: Planning to Paint Your House

Work in Groups (2-3 students)

Materials:

- • Paper and pencil
- • Calculator
- • Measuring tape (optional)

Context:

Imagine you want to paint parts of your house or objects within your house. You need to calculate how much paint to buy and how much it will cost. A small bucket of paint costs 500 ksh and is sufficient to cover 5 m^2.

Tasks:

1. (a) Think about parts of your house or objects you may want to paint. List at least three examples (e.g., pillars, walls, boxes, roof, doors).
2. (b) For each object, determine what kind of shape it is (cylinder, rectangular prism, pyramid, etc.) and estimate its dimensions.
3. (c) For each object, determine whether you would paint the entire object or only parts of it (e.g., pillar without top and bottom, wall without floor).
4. (d) Calculate the surface area that you want to paint for at least one object.
5. (e) Calculate how many buckets of paint you need and the total cost.
6. (f) Share your findings with the class. Discuss: Why is it important to calculate surface area accurately before buying materials?

Teacher Guidance for Anchor Activity

This anchor activity helps students connect surface area calculations to real-world planning and budgeting. By identifying objects in their own homes and estimating costs, students see the practical value of geometry.

Facilitation Strategy:

- • Organize students into groups of 2-3
- • Encourage students to think of familiar objects from their homes
- • Guide students to identify shapes: "Is the pillar a cylinder? Is the box a rectangular prism?"
- • Remind students to use consistent units (convert cm to m)
- • Ask: "Do you paint the top and bottom of a pillar, or just the curved side?"
- • Probe: "If one bucket covers 5 m^2 and your area is 3 m^2, how many buckets do you buy?"
- • Students should discover: Surface area determines material needs and costs

Phase 2: Structured Instruction (10 minutes)

Key Takeaways

After students have explored through the anchor activity, formalize their discoveries with these key concepts:

1. Surface Area in Real-Life Applications

Surface area is a fundamental geometric concept with many practical uses:

- • Engineers: Calculate heat transfer and cooling rates
- • Manufacturers: Estimate coating, painting, or material needs
- • Architects and landscapers: Plan cladding, tiling, or irrigation coverage
- • Scientists: Model reactions at interfaces (catalysis, evaporation)
- • Homeowners: Calculate paint, wallpaper, roofing materials

2. Surface Area Determines Material Needs

Surface area calculations determine how much material is needed to cover an object (paint, fabric, roofing, cladding). Accurate calculations reduce waste and help estimate expenses.

3. Unit Consistency is Critical

Always use consistent units before computing areas. Convert measurements when necessary (e.g., cm to m). Mixing units leads to incorrect calculations and costly mistakes.

4. Recognize and Apply Correct Formulas

Shape	Lateral Surface Area	Total Surface Area
Cylinder	$2\pi rh$	$2\pi rh + 2\pi r^2$
Rectangular Prism	$2h(l + w)$	$2(lw + lh + wh)$
Pyramid	Sum of triangle areas	Lateral + base area
Cone	πrl	$\pi rl + \pi r^2$
Sphere	N/A	$4\pi r^2$

5. Lateral vs. Total Surface Area

Distinguish between lateral and total surface area depending on whether ends/bases are included in the coverage:

- • Lateral surface area: Only the curved or side surfaces (e.g., painting a pillar without top/bottom)
- • Total surface area: All surfaces including bases (e.g., wrapping a gift box completely)

6. Surface Area Links to Cost and Planning

Surface area directly determines:

- • How much material to purchase
- • Total cost of materials
- • Number of units needed (buckets of paint, rolls of fabric, sheets of roofing)
- • Waste reduction through accurate estimation

Scaffolding Strategies

Address common challenges revealed during the anchor activity:

- • Emphasize unit conversion as a separate explicit step
- • Use visual diagrams showing which surfaces to include
- • Provide formula reference chart for common shapes
- • Connect calculations to real costs to make math meaningful
- • Decompose complex objects into simpler shapes

Phase 3: Practice and Application (15 minutes)

Worked Examples

Example 1: Painting a Cylindrical Pillar

We want to paint a round pillar in our house. It is 3 meters tall and has a radius of 15 cm. If a small bucket of paint costs 500 ksh and is sufficient to cover 5 m^2, how much does it cost to paint the pillar?

Solution:

Step 1: Standardize the units. Height h = 3 m, Radius r = 15 cm = 0.15 m

Step 2: Calculate lateral surface area (curved side only, not top/bottom).

$A = 2\pi rh = 2 \times \pi \times 0.15 \times 3 = 0.9\pi \approx 2.827\ m^2$

Step 3: Determine buckets needed. Area = 2.827 m^2, Coverage per bucket = 5 m^2

Since 2.827 < 5, we need 1 bucket.

Step 4: Calculate cost. 1 bucket × 500 ksh = 500 ksh

Answer: 500 ksh

Example 2: Roofing a Pyramid-Shaped Roof

For a house whose base is a square of 6×6 meters we want to construct a roof that has a pyramid shape. The diagonals from the edge to the top are 5 meters long. If a square meter of roofing material costs 2000 ksh, how much does the roofing material cost?

Solution:

Step 1: Identify triangle dimensions. Each triangular side has: a = 5 m, b = 5 m, c (base) = 6 m

Step 2: Calculate area using Heron's Formula.

Semi-perimeter $s = (5 + 5 + 6)/2 = 8$ m

$\text{Area} = \sqrt{[s(s-a)(s-b)(s-c)]} = \sqrt{[8\times3\times3\times2]} = \sqrt{144} = 12\ m^2$

Step 3: Total roofing material. Four identical triangles: $12 \times 4 = 48\ m^2$

Step 4: Calculate cost. 48 × 2000 = 96,000 ksh

Answer: 96,000 ksh

Example 3: Covering a Spherical Ball with Leather

A spherical ball has radius 15 cm. How much leather is needed to cover the entire surface? If leather costs 1200 ksh per square meter, estimate the cost.

Solution:

Step 1: Convert radius to meters. r = 15 cm = 0.15 m

Step 2: Calculate surface area of sphere. $A = 4\pi r^2 = 4\pi(0.15)^2 = 4\pi(0.0225) = 0.09\pi\ m^2$

$A \approx 0.09 \times 3.14159 \approx 0.283\ m^2$

Step 3: Calculate cost. $0.09\pi \times 1200 = 108\pi$ ksh ≈ 339.3 ksh

Answer: 0.283 m^2 of leather, costing approximately 339 ksh

Example 4: Wrapping a Gift Box

A gift box is a rectangular prism with dimensions 40 cm × 30 cm × 25 cm. How much wrapping paper (in square meters) is required to cover the entire box?

Solution:

Step 1: Convert to meters. l = 0.40 m, w = 0.30 m, h = 0.25 m

Step 2: Calculate total surface area. SA = 2(lw + lh + wh)

SA = 2(0.40×0.30 + 0.40×0.25 + 0.30×0.25)

SA = 2(0.12 + 0.10 + 0.075) = 2(0.295) = 0.59 m^2

Answer: 0.59 m^2

Individual Practice (Students work independently)

Provide students with similar problems to solve:

7. 1. A cylindrical water tank has radius 2 m and height 5 m. How much paint is needed to cover the curved surface only?
8. 2. A conical tent has base radius 3 m and slant height 5 m. Find the lateral surface area.

9. 3. A cubical box has side 50 cm. How much fabric is needed to cover all six faces? Express in m^2.

Phase 4: Assessment - Exit Ticket (5 minutes)

Students complete individually to demonstrate understanding:

Question 1: A cylindrical pillar has radius 20 cm and height 4 m. Calculate the lateral surface area in m^2. If paint costs 600 ksh per bucket and one bucket covers 6 m^2, how much does it cost to paint the pillar?

Question 2: Why is it important to use consistent units when calculating surface area for real-life applications?

Question 3: Explain the difference between lateral surface area and total surface area. Give an example of when you would use each.

Exit Ticket Answer Key

Question 1:

Convert: $r = 0.20$ m, $h = 4$ m

$A = 2\pi rh = 2 \times \pi \times 0.20 \times 4 = 1.6\pi \approx 5.03\ m^2$

Buckets needed: $5.03/6 < 1$, so 1 bucket

Cost: $1 \times 600 = 600$ ksh

Question 2:

Using consistent units prevents calculation errors and ensures accurate material estimates. Mixing cm and m leads to incorrect surface areas, which causes buying too much or too little material, wasting money or delaying projects.

Question 3:

Lateral surface area includes only the side surfaces (not bases). Use when painting a pillar without top/bottom. Total surface area includes all surfaces including bases. Use when wrapping a gift box completely or covering a ball entirely.

Differentiation Strategies

For Struggling Learners:

- • Provide formula reference cards
- • Break calculations into explicit steps: 1) Convert units, 2) Apply formula, 3) Calculate cost
- • Use simpler shapes (cylinders, rectangular prisms) initially
- • Provide worked example templates to follow
- • Use visual diagrams showing which surfaces to include

For Advanced Learners:

- • Challenge with composite solids (multiple shapes combined)
- • Introduce optimization problems (minimize cost while meeting requirements)
- • Explore irregular shapes requiring decomposition
- • Connect to careers (architecture, engineering, manufacturing)
- • Calculate waste percentages and efficiency

Real-World Connections

Surface area calculations are essential in:

- • Home improvement: Painting walls, roofing, tiling
- • Manufacturing: Coating products, packaging design
- • Engineering: Heat transfer, cooling systems
- • Agriculture: Irrigation coverage, greenhouse design
- • Medicine: Drug delivery, surface reactions
- • Environmental science: Evaporation rates, solar panel efficiency

Post-Lesson Reflection for Teachers

- • Did students successfully connect surface area to real-world applications?
- • Were students able to identify which surfaces to include in calculations?
- • What misconceptions emerged about units or formulas?
- • How engaged were students with the house painting activity?
- • Did students understand the link between surface area and cost?
- • What adjustments are needed for future lessons on this topic?